

Post Occupancy Evaluation of Institution Building at NIT Tiruchirappalli Campus

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ABSTRACT: A Post occupancy evaluation (POE) typically includes a combination of quantitative and qualitative techniques. Most POEs can involve seeking feedback from the occupants of the place being evaluated; this could be achieved through numerous survey methodologies together with questionnaire, interview or focus group. The user feedback could also be supplemented by environmental monitoring, like temperature, noise levels, lighting levels and indoor air quality. The study aims to review through Post Occupancy evaluation (POE) idea in distinguishing performance issue and drawback and to work out the practical performance satisfaction level from the building occupant's perspective. Another aim is to develop a conceptual conducive design guideline or framework for educational building. The finding disclosed that building performance criteria extremely correlated with the occupant's satisfaction.

KEYWORDS: Post occupancy evaluation (POE), Occupant's comfort, user survey, expert evaluation.

I. INTRODUCTION

The actual briefed definition of POE comes as- "the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time" POE can be defined as the process of evaluating buildings in a systematic and rigorous manner after they have built and occupied for some time (Presier, 1998). POE is very important in building performance evaluation because it contains the techniques that are used to evaluate whether a building meets the user's needs. The POE processes extended from professional evaluation to organizational evaluation of previously built buildings (Cleveland and Kenn, 2013). Now-a-days POEs are organized on Educational and Hospital buildings (Shepley et al., 2009). POEs can deliver the positive and negative aspects earlier of the completed project (Zengel and Kaya, 2011), and the information's can be determined to develop the building further or to develop the next level of the project (Zimmerman and Martin, 2001).

POEs are intended to the need and essentials of building users; hence POEs varied from the other kind of building performance evaluation. Meneses et al., 2012 states that there is a gap[between the designed and the real performance of the building. The need for evaluating the education building is derived from the aspiration to collect the informative data that can brief the future decisions (Reza T.Ahmadi, Diana Saiki and Charles Ellis, 2016). The positive learning atmosphere enhances the knowledge interest, passion in education and increase participation and confinement in education (MarwaN.Charkas et al., 2016).The study involves the users as fulcrum in POE process which means taking the correlation between the various kinds of key performance elements into consideration. Especially the study focused on the thermal comfort of the building since this will affect the energy consumption of the building and the student's well-being.

The ORION building, NIT Tiruchirappalli is located at the eastern side of architecture Department and southern side of GJCC hall. This can be a north-south destined building with thirty six school rooms distributed in three floors. Two inner courtyards are pleasant and serving very well for ventilation and natural light. A multi-directional setup of classrooms provides multiple comfort level and totally different experience of light and ventilation in different classrooms. The octagonal base extends its wings as classrooms and changes into circular form for courtyard (basically

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beautiful lawn) at the centre. The relative location of the ORION building to the student’s hostel in the campus is shown in the [Table 1](#).

Table 1. Proximity location of ORION building to Student’s Hostel

Proximity from Student’s Hostel	
Hostel	Distance (in Meters)
Opal	1600
Agate	550
Diamond	750
Corel	750
Beryl	1000
Emerald	1000
Pearl	1000
Rubby	1200
Sapphire	1000
Topaz	1200
Jade	1200
Lapis	850
Garnet	500
Zircon	1400
Aquamarine	1700

II. METHODOLOGY ADOPTED AND SCOPE

Visual Walkthrough

The authors went for primary visual survey of the building and primary assumptions about the building were made. The walkthrough inside and outside of the building helped to understand the general facilities, space dimensions, natural light and ventilation in a very generalized way. This beautiful building seems pretty modern and grand from inside with maximum number of facilities available.

Analysis of Plan

The plan showed a nice play of octagonal base projecting 6 classrooms in multi-direction, 1 toilet wing and 1 connectivity wing to other mirror-block constituting the big and beautiful “ORION”. The building is a three-story building with 36 classrooms in multi directions. The octagonal base ends inside into a circular courtyard.

Area of Study

From the primary visual survey, this was clear that the study area for finding the comfort of the users, the response sections have to be divided primarily into (a) Students, (b) Teachers and (c) Supporting Staffs.

User Survey

For user survey, authors concentrated the response forms in collecting the information about (a) The site and its facility provisions, (b) Comforts with and without mechanical installations inside the building, (c) Aesthetical aspects and (d) Other facilities provided like universal design, fire safety etc.

Collection of Data

For collection of data, both online and offline procedures were applied and major responses from students had been found as were expected (they proclaims the lion’s share of occupancy here). The responses from supporting staffs were taken manually and all the collected responses were compiled together to analyze the collected data. All the responses were read carefully and the information provided was noted down where necessary. After collecting and analysing the data from the responses the next step was planned and executed.

Technical Survey

From the plan, primary visual walkthrough and collected responses, the authors already got a major idea about the building. The next part was to technically observe every detail in a strategic way. The problem and facility areas

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found in the responses were kept into considerations, the observation of amenities and basic facilities were focus with respect to the standards. All the survey was carried on visually and all the noticeable things were noticed and noted whichever were necessary or seemed important.

III. ANALYSIS OF DATA

The data from the Visual survey and the response forms were put together and analysed by the authors to come up with a summary and conclusion.

Expert Evaluation Data

Site and parking

The site is having four parking structures. Parking 1 and parking 2 are used by boys and parking 3 is used by girls. Parking 4 is not in use. Students coming from the northern side of the site (especially boys) use parking 1 and parking 2 for. And it is sufficient in quantity. Parking 4 is not used due to the lack of proper access road. Students coming from the southern side of the site (especially girls) use parking 3 for parking their cycles. But it has a limited number of parking. Hence students are forced to park their cycles on the ground without a shading structure. Two wheeler parking is provided for staff members. No signage is provided for exit or entrance roads. Landscape is not properly done in the site. Closed drainage trenches are provided on either sides of access road. Drainage near to the porch is not maintained properly.

Building Description

The ORION building at NIT, Trichy, is located within walking distance from the academic buildings on the Institute. The building is three story, transparent and RCC structure, where 50% of the façade contains of glass curtain walls. The ground floor area of the building is approximately 4900 m². This area mainly contains of 12 class rooms, 2 courtyards, 4 toilets, 3 staircases and porch. Similarly, the typical floors consist of 12 classrooms, 4 toilets and 3 staircases. The facilities such as fire extinguisher, fire hose reel near toilet and water coolers are provided in each floor. The ORION building was built and used in 2014. Since its construction, there was no POEs conducted to record the user satisfaction in the building. [Fig 1](#) illustrates the layout of the ORION building.

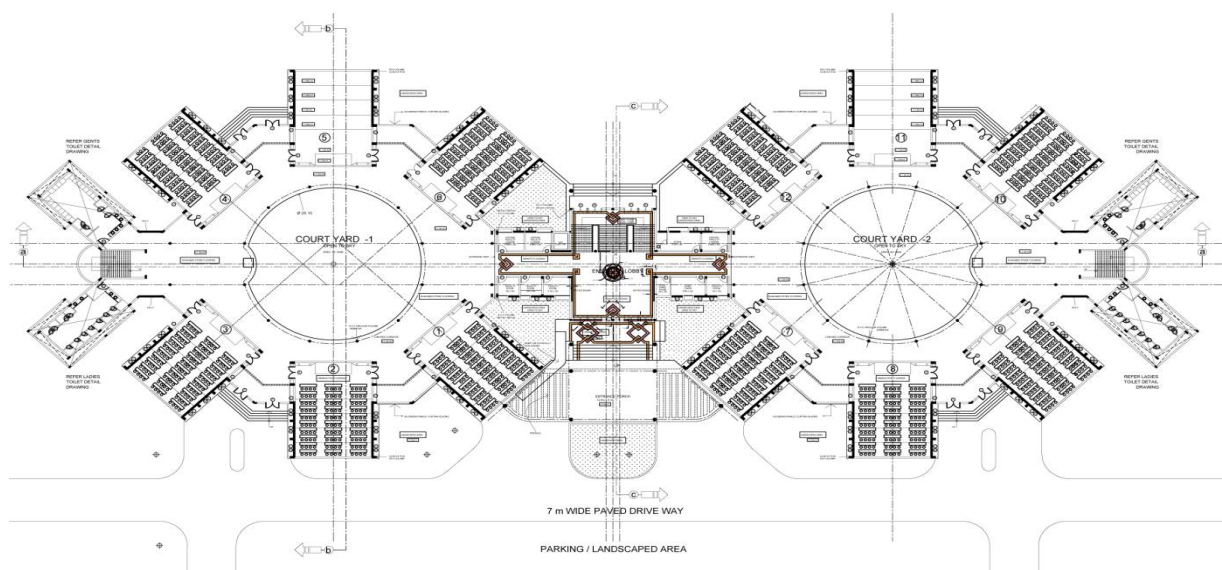


Fig 1. Layout of the ORION building

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User satisfaction survey

In user Satisfaction survey, the authors concentrated on major section as follows:

Functionality and design

The user's provision in the building included the entrance, distribution of the classrooms, provisions of accessibility and understanding of route. The user's ease of access from entrance (for day scholars) and respective hostels, the parking available for the user (students, staffs and supporting staffs), the walking distance from parking to the building, flow inside the building etc. Table 2 shows the response of the users about the functionality and design of the building.

Indoor Comfort

The indoor comfort of the building is studied as the important performance element in any building includes the institute building (ASHARE, 2013). This includes the users comfort in different major ways like (a) Thermal Comfort- includes air temperature, air speed, relative humidity & radiations from mass (b) Visual Comfort- includes daylight, artificial light, reflection from facades etc. (c) Acoustical Comfort includes level of echo & reverberations and (d) Spatial Comfort- includes the level of efficient user facilities. Table 2 shows the users satisfaction about the indoor comfort of the building.

Table 2. Result of the Satisfaction Survey from the users.

No	Question	Likert scale (%)				
		1	2	3	4	5
Functionality and design						
1	Is the building functionality good?	10.8	12	42.6	27.8	14.8
2	Does the design and layout of the spaces facilitate easy maintenance	0.1	7.8	51	28.4	12.7
3	How effective is the shading provided in the building?	1.3	2	11	68.6	17.1
Indoor comfort						
4	How do you feel with the temperature in the building?	8	48	14	18	12
5	How satisfied are you with the natural day lighting in this building?	0	0	13	42	45
6	What is your rate for the overall acoustic in this building	0	0	47	33	20

IV. BUILDING ANALYSIS AND SIMULATION

EPW file of Tiruchirappalli was the base to understand and analyse the climatic data of the site. Major factors like DBT, WBT, RH, Wind Speed, TSI & Comfort zone were targeted and extracted from the data to understand the nature and the major design considerations. 3 types of major simulations were done on the basis as follows as:

- Shadow Analysis: A SketchUp plugin that determines the range of shadows on and around the building;
- Sun Hours: A SketchUp plugin that calculates the no of hours of sunray the building will receive; &
- Flow Design: An Autodesk plugin that describes the air flow pattern around the building.

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Shadow Analysis

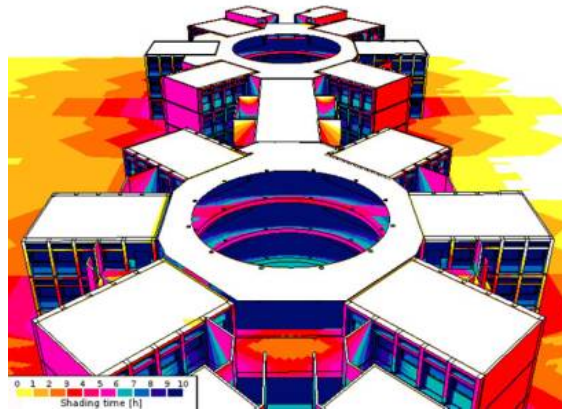


Fig 2. Shadow Analysis of ORION building

[Fig 2](#) shows the shadow analysis of ORION building with shading time. The building is facing in the East direction so the East façade getting the maximum sunlight. The building is getting the sufficient amount of shade because of the design. The low emissive glasses are used in the building façade to reduce the glare.

Sun Hours

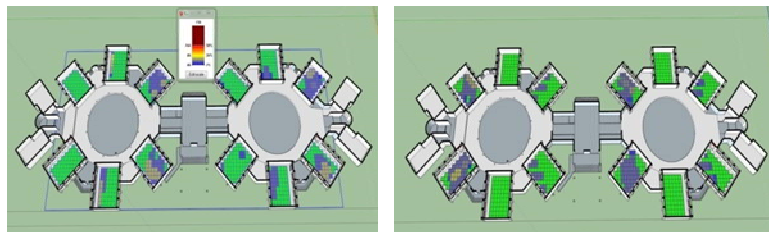


Fig 3. (left) During winter and (right) during summer

[Fig 3](#) shows the radiation of sun on the ORION building during winter and summer. This analysis is used to determine the daylight parameter of the buildings. The results of the analysis show that the buildings have sufficient hours of direct sunlight in the winter also.

Flow Design

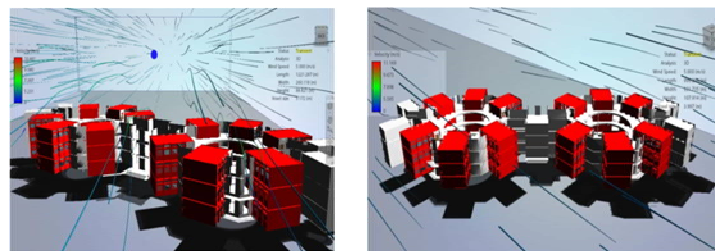


Fig 4. (left) Wind flow during summer and (right) during winter

[Fig 4](#) shows the wind flow diagram of the ORION building during the summer and winter. The courtyard creates a negative pressure to attract more wind and distributes it. Due to the multi-geometry of the structure, the negative

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pressure is less in inside building. During winter, the wind speed is upto 8.11 mt/sec. the wind flows inside the building through the windows and the full-length wall ventilators.

V. CONCLUSION AND RECOMMENDATION

Students are happier with the building functionality but almost half of the students don't feel comfortable inside the class room even though they are getting good ventilation. Almost all the students feel comfortable in circulation areas and they are happy with the number of toilets and toilet ventilation also. Students like the design and architecture of the building and some of them appreciating the size of the class rooms and courtyard while some students criticize the structure and basic services of the building like wc in toilets, water availability etc. Almost all the students feel safe in the site, and they are very happy with the spaces provided for the specially needed students. Some students are not happy with parking shade given. Most of the students are satisfied with shading provided in the building; the dissatisfy students are finding reasons like lack of ventilation and the effect of incoming sun.

Analysis of building

- Aesthetically the best building of the campus as per users
- Massing (multi-geometry) plays a great role in assessing natural light and ventilation
- Window heights are very well designed to play with solar altitude
- Large size modern classrooms satisfies maximum students, problem arises in acoustic
- Abundant circulation spaces
- Symmetric plan helps in way finding

Recommendations

- Acoustic treatment should be done in classrooms.
- Proper provision of drinking water on every floor is required.
- Provision for more number of parking for cycle.
- Solar panel can provide as shading device they play dual role, they provide shade and generate electricity.
- Proper provision for paved way for cycle to enter in parking area.
- Green spaces around the building should be maintained properly at regularly at certain interval of period.
- Open drainage should be proper covered.

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